
CELLULAR DIGITAL PACKET DATA

This document describes various aspects of cellular digital packet data (CDPD). It provides only a “snapshot” of CDPD services today, recognizing that technology is evolving, and industry is introducing new services and capabilities at a rapid pace. This document is not intended to reflect a government position or endorse a particular service provider or service. Rather, it is provided to offer broad industry information on CDPD. We invite comments to ensure that the most current information is included in our analyses.

If you have comments regarding the information contained in this document, please contact the Public Safety Wireless Network (PSWN) Program Management Office (PMO) at 800-565-PSWN or access the PSWN Program Home Page at: www.pswn.gov.

Public safety agencies rely heavily on their land mobile radio (LMR) networks for communications and coordination within and among organizations. In the past few years, commercial services such as cellular telephones and paging have provided powerful capabilities that complement existing public safety networks. It is important that public safety communities carefully evaluate, assess, and maintain current information on the expanding commercial wireless marketplace. This allows informed, objective assessments that will ultimately meet mission requirements.

The Increasing Importance of Wireless Data Services

Emerging wireless data services potentially provide greater efficiency for the mobile work force. Mobile data applications are an increasingly important communications tool for government, business, and private users. Data applications, such as electronic mail and database look-ups (e.g., name searches or license plate queries), are also becoming increasingly

important for mobile users. Commercial carriers have developed a variety of wireless data services to meet this growing need. One of these services is cellular digital packet data (CDPD). This report describes CDPD services, discusses some of the key CDPD performance characteristics, provides sample costs, lists some considerations in selecting CDPD services, and provides a checklist to assist in determining whether CDPD meets user needs.

What is CDPD?

CDPD is a wireless data service that uses the cellular network to provide packet data capabilities. In fact, CDPD uses a data format similar to the one used for Internet communications. This allows most data applications to be supported through CDPD services. CDPD divides information into “packets” of data that are transmitted over the cellular network. Important CDPD considerations and definitions are illustrated in Exhibit 1.

Availability	Identifies whether CDPD services can be acquired from a carrier in a given region
Coverage	Identifies whether CDPD transmissions can reach users in a given service area
Reliability	Identifies whether users can access and use CDPD services during congestion or network disruption
Transmission Speed	Describes the end-to-end data speed, including call set-up time and transmission speed
Privacy and Security	Describes the level of inherent privacy and security of the service and the capability to add security measures
Cost	Characterizes the costs typical of CDPD services

Exhibit 1
Key CDPD Characteristics

Availability

At this writing, CDPD is available in more than half of the geographic United States and in 30 international markets. CDPD carriers use “roaming” agreements to extend their regional services to other areas outside their region. Therefore, as long as CDPD services are available, CDPD subscribers can use CDPD as they cross service areas or if they are on travel to different parts of the US.

Coverage

Carriers will typically deploy networks to provide services in areas with high population density, such as metropolitan areas and along roadways. Consequently, carriers may not provide full coverage in rural areas or beyond these major roadways. This is a key consideration for users

that expect and need contiguous service off the beaten path.

Whether in the carrier’s region or when roaming, CDPD users will often experience coverage gaps similar to cellular voice services. This often occurs in less populated areas or away from major roads. Coverage gaps can be caused by terrain or buildings that interfere with the signal. They are also due to “dead spots” within the region, where the carrier’s signal is too weak or non-existent. Users should match operational requirements to CDPD coverage considerations to ensure the service is available when and where they need it.

Reliability

Users of commercial systems share the airwaves and compete for capacity with one another. Therefore, users may experience congestion if

there is more demand than network capacity. Congestion within CDPD networks will cause delays in setting up a connection and transmitting information.

The likelihood and effect of congestion depends, in part, on the type of CDPD network implemented. The two network types are channel hopping networks and dedicated channel networks.

CDPD channel hopping takes advantage of capacity unused by cellular voice subscribers to transmit information. This means that the capacity available for CDPD is directly associated with the level of use by cellular voice calls. During peak periods or emergencies when voice traffic on cellular networks tends to increase significantly, the likelihood of CDPD users experiencing congestion may increase significantly – causing call set-up and transmission delays.

The other configuration uses dedicated channel networks. This technique dedicates capacity on a portion of the cellular network that is available for CDPD use only. Therefore, CDPD capacity does not vary as cellular voice calls increase or decrease. CDPD transmissions do not compete with cellular voice calls. To the CDPD user, this is an important improvement because CDPD performance is not affected when the cellular

voice system is congested. Users must still compete with other CDPD users for call setup and channel capacity.

Cellular carriers will often use channel hopping when they first introduce CDPD service, in smaller cities, or where CDPD usage is low. They will implement dedicated channels in larger cities where the service has been offered for a number of years and demand is high. These network implementation strategies have significant implications for reliability. Users should exercise caution to ensure that service reliability will not affect critical operational requirements.

Transmission Speed

CDPD can provide a maximum link data rate of 19.2 kilobits per second (kbps). The actual user transmission speeds are less – typically from 10 to 12 kbps – when the application overhead is included [1]. The exact transmission speed varies among vendors and is affected by the level of traffic on the network. This can mean a 10 kilobyte file (which contains approximately 1500 words, or 3 text pages) will take up to 15 seconds to transmit. Times to send files of different sizes are provided in Exhibit 2 [2].

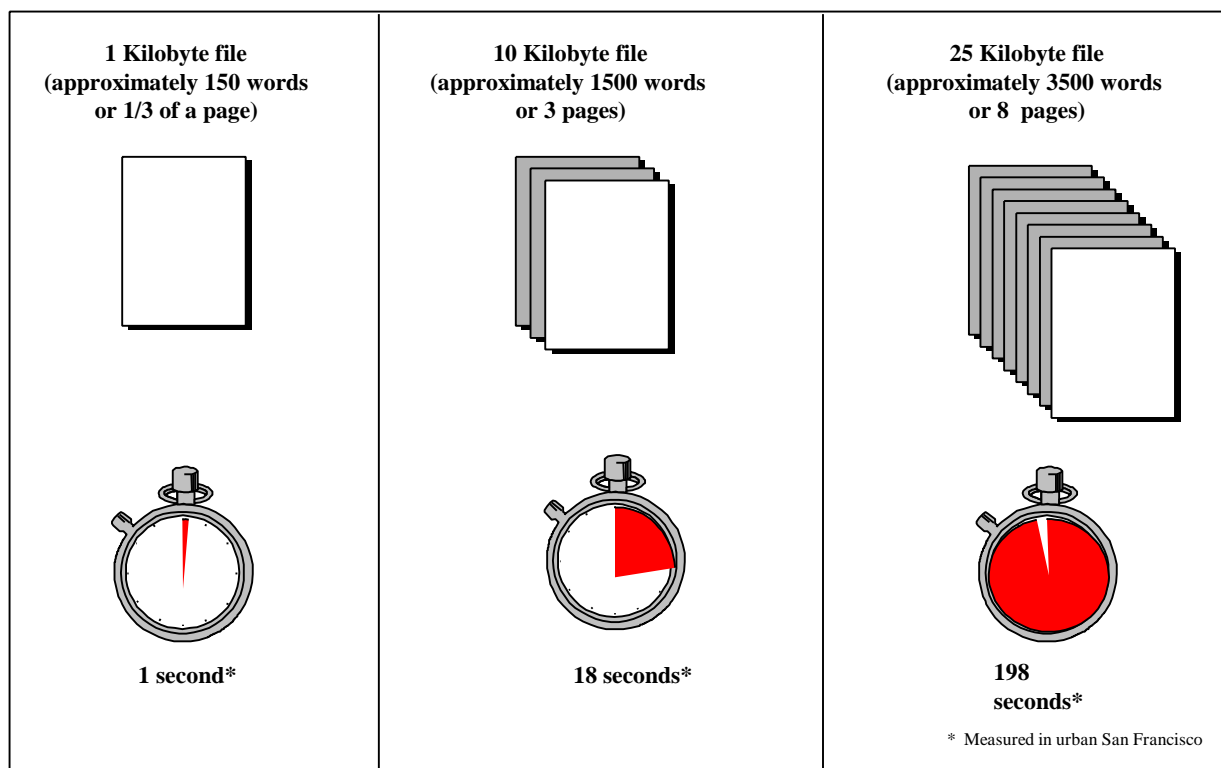


Exhibit 2
Sample Transmission Times for Different Sized Files

Call Set-Up Times

Call set-up time is the time it takes to begin transmitting information after the user pushes the transmit button. CDPD call set-up times range from less than 1 second to 3 or 4 seconds [3]. Differences in call set-up times may depend on the user terminal processing speed and the users' ability to access the network.

From the user's point of view, the overall time to transmit data is equal to the call set-up time plus the transmission duration. Using the example from above, the overall time needed to transmit a 10 kilobyte file is 18 seconds (3 seconds for set up and 15 seconds for transmission).

Privacy and Security

CDPD privacy features include automatic identification and authentication, to limit unauthorized, fraudulent access and data interception. Channel-hopping transmissions are more difficult to intercept than dedicated channel transmissions, since they often change channels between transmission of packets. However, intercepting channel-hopped communications is possible. CDPD does use a standard form of encryption to protect information sent over the air. For users with more robust security requirements, end-to-end encryption schemes should be considered. Users should also consider the security practices of the service provider,

with the respect to physical, operational, and information security.

User Equipment

Users typically require two pieces of equipment to use CDPD services: a CDPD modem and a user terminal. Key factors to consider when purchasing CDPD modems and user terminals for mobile users include functionality, device ruggedness, ease of use, battery life, computational power, display quality, warranty, and cost.

CDPD Modem

The CDPD modem includes the wireless antenna and the modem that provides compatibility with the CDPD network. CDPD modems can either be internal to the user terminal (built-in or removable, such as a PCMCIA card) or external through a standard port. Because CDPD modems are based on personal computer standards, they are not specific to a particular carrier or manufacturer. CDPD modems typically range from \$450 to \$1000, depending on functionality and performance [4]. Users can buy standard CDPD modems from a number of manufacturers and use them on any CDPD network.

User Terminal

Any device that supports IP-based data communication can use CDPD. Business users employ different types of user terminals, which vary in terms of size and utility: notebook or laptop Personal Computers (PCs), handheld

computers or PCs, pen-based computers, Personal Digital Assistants (PDAs), and wireless handsets. User terminal costs vary significantly based on the level of functionality, processing power, display characteristics, and vendor

CDPD from a Network-Level Perspective

CDPD is a packet data service that uses the existing analog cellular network infrastructure. Exhibit 3 describes the transmission of user information from a mobile user device to a database that is located in the user's office. When the user hits the transmit button, the information is divided into packets and bundled with "overhead" information about the route and destination address of the distant computer or terminal. For the example in Exhibit 3, this endpoint is shown as the user database. These packets are sent over the airwaves and received by a nearby cellular antenna, where it enters the CDPD network.

From this point, the packets are routed to the local CDPD switch. Based on the routing information, the switch directs the data to the user's local network and, eventually, to the target database. As in Exhibit 3, the information retrieved from the database would generally be routed back along the same path to the CDPD user.

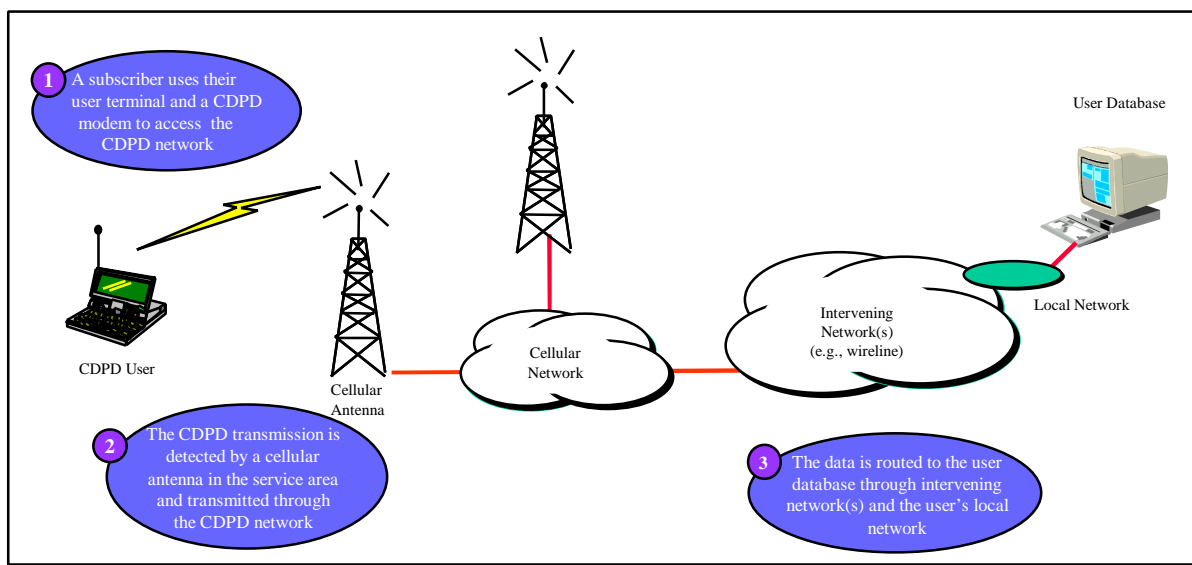


Exhibit 3
CDPD from a Network Perspective

CDPD Costs

Service pricing structure and service rates vary by carrier and pricing plan. There are currently two major types of pricing plans: flat rate and usage based.

For flat-rate pricing, users pay a set amount for unlimited usage. This pricing plan is advantageous to those who expect to make heavy use of CDPD services.

The second pricing plan uses a two-tiered approach. Users pay a set monthly price that allows for a fixed level of usage, and then they pay incrementally, on a per-kilobyte-transmitted basis, for usage beyond the fixed limit. Usage costs may vary depending on whether the user is calling within the carrier region or the user is roaming in another carrier's region. A typical pricing plan is shown in Exhibit 4 [5].

SERVICE PLAN	PLAN TYPE			
	A	B	C	D
Monthly Access Charge	\$14.95 (150 Kb Allowance)	\$29.95 (400 Kb Allowance)	\$49.95 (1,100 Kb Allowance)	\$89.95 (4,000 Kb Allowance)
Additional Per Kb Charge Over Plan Limit (In Region)	\$0.10	\$0.08	\$0.05	\$0.04
Additional Per Kb Charge Over Plan Limit (Out of Region)	\$0.10	\$0.10	\$0.10	\$0.10

Exhibit 4
Example Pricing Plan

CDPD Considerations

Users must think carefully about what commercial services may meet their operational requirements. Exhibit 5 provides some considerations in selecting CDPD services. Remember that CDPD service packages and

carriers. Before acquiring CDPD services, potential users may choose to employ the checklist at Exhibit 6 to assist in determining whether CDPD meets their needs.

CDPD Considerations

- **Cost**— CDPD prices are based on the amount of data rather than the length of time over which communications occur. Therefore, a user can maintain access to the network and incur charges only for the data exchanged. This is important if a connection must be maintained for an extended period.
- **Mobility**— CDPD may be used while traveling at high speeds. It has been tested traveling at speeds more than 85 miles per hour resulting in no signal degradation.
- **Transmission Speed**— CDPD can provide wireless data communications at speeds up to 19.2 kbps. The actual transmission speed is 10 to 12 kbps. This is considered good relative to other wireless data services.
- **Compatibility**— CDPD supports multiple protocols, which allows access to many networks and databases.
- **Flexibility** - With CDPD, there is no need to build a private network, reducing initial costs. Users can quickly adopt new services, and scale up to meet expanding needs. Users may also switch between service providers in areas with more than one provider offering CDPD services.
- **Coverage**— Although CDPD is available in most major metropolitan areas, rural coverage is sparse. Cellular carriers are continuing to implement CDPD in their cellular networks to expand CDPD coverage.
- **Roaming**— Although inter-carrier agreements have been signed among several carriers, additional agreements must be created to provide uninterrupted nationwide coverage.
- **Coverage Gaps**— Some CDPD networks may have gaps in coverage, depending on geographic terrain, shadowing from buildings, and network build-out.
- **Reliability**— It is likely that data transmission may be delayed if the cellular network becomes congested. Delays are more likely to occur on channel hopping than on dedicated channel CDPD implementations.

billing structures are likely to vary among

Exhibit 5 Considerations in Adopting CDPD Services

CDPD CHECKLIST

- ☒ Do I need a mobile data service?
- ☒ Where do I need mobile data services? Locally? Regionally? Nationally?
- ☒ What data services are available to meet my needs? Will this work in my current operational environment?
- ☒ Will it support mission-critical requirements?
- ☒ What is the coverage of the carrier's CDPD network?
- ☒ Do known coverage gaps exist? Where?
- ☒ Will the provider address my coverage gaps in areas where I know I will need CDPD services?
- ☒ Are there regional or nationwide roaming agreements? With whom?
- ☒ Is the provider's network a dedicated or a channel hopping network?
- ☒ What is the average transmission speed?
- ☒ What maximum delay in accessing the network will the carrier guarantee?
- ☒ What type of service and pricing plans are offered?
- ☒ How do the service plans rate against my needs?
- ☒ Are volume discounts or flat-rate pricing plans available?

Exhibit 6

User Checklist of Questions to Better Understand the CDPD Service

APPENDIX A LIST OF ACRONYMS

CDPD	Cellular Digital Packet Data
IP	Internet Protocol
Kb	Kilobyte
kbps	Kilobits per second
LMR	Land Mobile Radio
MDT	Mobile Data Terminal
PC	Personal Computer
PDA	Personal Digital Assistants
PMO	Program Management Office
PSWN	Public Safety Wireless Network

APPENDIX B REFERENCES

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